Epitomes
Important Advances in Clinical Medicine

Neurosurgery

The Scientific Board of the California Medical Association presents the following inventory of items of progress in neurosurgery. Each item, in the judgment of a panel of knowledgeable physicians, has recently become reasonably firmly established, both as to scientific fact and important clinical significance. The items are presented in simple epitome and an authoritative reference, both to the item itself and to the subject as a whole, is generally given for those who may be unfamiliar with a particular item. The purpose is to assist busy practitioners, students, research workers, or scholars to stay abreast of these items of progress in neurosurgery that have recently achieved a substantial degree of authoritative acceptance, whether in their own field of special interest or another.

The items of progress listed below were selected by the Advisory Panel to the Section on Neurosurgery of the California Medical Association, and the summaries were prepared under its direction.

Brachial Plexus Birth Injury

THE FIRST EXPERIENCES with brachial plexus exploration in the infant were reported 85 years ago, in which gratifying functional recoveries occurred after the direct suture of ruptured upper plexus elements. Because surgical and anesthetic techniques were relatively primitive, only a few surgeons achieved consistent, satisfactory results, and by the mid-1920s, surgical attention had shifted from the reanimation of paralyzed muscle groups to mitigating the skeletal consequences of paralysis, contracture, and joint deformity.

Two major developments have revived the practice of brachial plexus exploration for infants with birth injuries. The first is a refinement of the peripheral nerve microsurgical procedures and pediatric anesthesia that has made long procedures to reconstruct miniature infant brachial plexuses both feasible and safe. The second is a recent clarification of the natural history of plexus birth injury that has shed invaluable light on the process of patient selection.

Between 75% and 95% of newborns with brachial plexus palsies will make complete, spontaneous recoveries. Identifying the minority who are destined to a degree of functional disability that might justify surgical intervention has been problematic. Initial flaccidity of the entire limb without any movements of the fingers or wrist has long been recognized as an adverse prognostic sign, as has the presence of Horner's syndrome. In the late 1970s the precision of early prognostication was advanced when the rates of recovery in a cohort of conservatively managed neonates were prospectively examined. Observations were distilled into the following succinct clinical rule: If perceptible muscle contractions have not returned to the deltoid and the biceps by the end of the third month, the ultimate functional recovery of the shoulder and the arm will be unsatisfactory.

This rule, which has been corroborated by several subsequent investigations, has encouraged the application of modern peripheral nerve microsurgical techniques to brachial plexus birth injuries. The most practical goal has been to reanimate the muscles supplied by the upper trunk: the abductors and external rotators of the shoulder and the flexors of the elbow. The most common pattern of injury, neuromata involving the C-5 and C-6 spinal nerves and the upper trunk, has been managed by excision and reconstruction with sural nerve grafts. In less common cases, when the C-5 and C-6 nerves have not been suitable for reconstruction because of intraforaminal injuries or avulsion from the spinal cord, distal upper plexus elements have been neurotized by using the intercostal nerves, the spinal accessory nerve, and other sources of motor outflow.

Surgical groups from Europe, Scandinavia, and the United States have reported gratifying clinical results. The largest experience has been 178 surgical cases reported from Paris. On the basis of previous natural history data, the researchers explored the plexuses of infants shortly after 3 months of age if there was no sign of recovery in the deltoid and biceps muscles by that point. Although brachial plexus reconstruction does not produce normal limbs, long-term results indicate that operative intervention generally improves on the natural history by one clinical grade. Morbidity has been minimal. Whether plexus exploration is of benefit in older infants and children is not clear.

Even under the best of circumstances, in the two- or three-year interval required for the results of plexus reconstruction to become apparent, infants may need the services of a developmental pediatrician, a physiatrist, an orthopedic surgeon, and physical and occupational therapists. The neurosurgical management of plexus injury should be one part of a comprehensive program, and a prototypic multidisciplinary clinic has been described.

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Endovascular Therapy for Intracranial Vascular Lesions

RECENT REPORTS HAVE SUGGESTED that various cerebrovascular lesions including intracranial aneurysms, vascular malformations, and vasospasm following subarachnoid hemorrhage can be treated successfully with interventional neuroradiologic techniques. Patients undergoing such endovascular therapy are often considered to be poor surgical risks or those in whom conventional neurosurgical tech-

niques have failed. These endovascular methods usually employ a transfemoral approach using local anesthesia and mild sedation. Intravascular catheters are guided into the intracranial circulation under direct fluoroscopic control. Detachable balloons may be placed in aneurysms or proximal vessels; various particles, thrombogenic coils, or glue may be injected into vascular malformations; or cerebral arteries narrowed by vasospasm may be dilated with microballoons. At present, these relatively new techniques have potential advantages but some limitations.

For difficult intracranial aneurysms, or for patients in poor medical or neurologic conditions, endovascular balloon occlusion of an aneurysm or feeding artery offers several benefits: an open craniotomy with general anesthesia and brain retraction is avoided; the patient's neurologic condition can be continually monitored during the procedure, and if the test occlusion is not tolerated, the balloon can be deflated; and an immediate, high-quality angiogram can be done following the balloon placement to verify the completeness of the occlusion and the patency of normal vessels. Serious pitfalls include immediate or delayed aneurysmal rupture due to subtotal occlusion and incomplete aneurysmal thrombosis; balloon rupture or balloon migration leading to hemorrhage or ischemic complications, especially in giant aneurysms wherein more than one balloon is required; persistent mass effect of the inflated balloons, even after aneurysmal thrombosis; and occlusion of the origins of perforators that are not angiographically visualized. Long-term follow-up in patients undergoing these procedures is still being conducted. Further research to find a safer endovascular therapy for difficult aneurysms is clearly warranted, and we are currently investigating the use of retrievable thrombogenic coils.

Endovascular embolization of intracranial vascular malformations is proving to be extremely valuable, usually as an adjunct to conventional microsurgical or radiosurgical procedures. Advantages include awake monitoring of patients with test injections of amobarbital sodium before definitive embolization; the ability to obliterate deep feeders or components of arteriovenous malformations (AVMs) that are surgically difficult; and the ability to stage the obliteration of large malformations, potentially allowing for the gradual return to normal of markedly altered hemodynamics. For large AVMs, we have recently been using embolization to reduce the nidus size before a radiosurgical procedure in an attempt to increase the obliteration rate and decrease the incidence of complications. In 45 patients receiving this combined therapy, the results are encouraging, although long-term follow-up is still needed. In select cases, such as carotid-cavernous fistulas, dural AVMs, vein of Galen aneurysms, and occasional parenchymal AVMs, endovascular treatment results in complete angiographic obliteration of the lesion. Limitations include the risk of inducing hemorrhage or infarction, either immediate or delayed; the small incidence of venous sinus thrombosis if a transvenous approach is used; and the possibility of AVM recanalization if the malformation is not removed. It is rare to obliterate completely a parenchymal AVM with endovascular treatment alone.

Balloon angioplasty for symptomatic vasospasm following subarachnoid hemorrhage is being attempted in specialized neurosurgical centers. Because delayed ischemic deterioration from vasospasm is still a major problem despite the use of hypervolemic, hypertensive therapy and systemic calcium antagonists, balloon angioplasty could have substantial therapeutic potential. Problems associated with

the method include aneurysmal rupture if its neck has not been secured; a failure to improve the neurologic condition if unrecognized infarction has already occurred; the risk of inducing hemorrhage in an infarcted territory; and difficulty gaining access to the narrowest (often most symptomatic) arteries, smaller arterial branches, and perforators. The long-term side effects of intracranial angioplasty are also not known.

Endovascular therapy for cerebrovascular disorders has already made a major positive contribution. At present it still has certain limitations and does not replace open microsurgical techniques for patients in good condition with accessible lesions. With further technical advances and improvements in patient selection criteria, its role will undoubtedly be expanded and become better defined.

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Implanting Fetal Tissue to Treat Parkinson's Disease

THE CONCEPT OF RESTORING NEUROLOGIC function by transplanting neural tissue is old. A clear demonstration of its feasibility, however, came in 1979 with the publication of two important studies. In both, the researchers partially reversed the behavioral abnormalities seen in rats with pharmacologically induced nigrostriatal lesions by transplanting fetal tissue into the brain. The clinical implications for Parkinson's disease are clear. The motor disturbances seen in patients with Parkinson's disease primarily result from the loss of dopaminergic neurons in the pars compacta of the substantia nigra. These neurons project to the striatum where the release of dopamine from synaptic vesicles modulates motor function. The systemic delivery of levodopa dramatically improves function in these patients, but the results are far from ideal. The local production of dopamine in the striatum by transplanted tissue holds the promise of even greater clinical improvement.

In the initial attempts at transplantation in humans, autologous adrenal tissue was used as the source for dopamine. At best, the results have been limited and transient. The mechanism underlying the observed improvements is not known, but autopsy studies and research in animals strongly suggest that the release of catecholamines by viable graft cells is not a factor. The bulk of the data obtained from studies of animals over the past ten years indicates that fetal brain tissue is superior to adrenal tissue for this purpose. In 1987 a Scandinavian team did the first implantation of fetal mesencephalic cells into the human striatum. Perhaps as many as 100 similar procedures have been performed throughout the world to date, although documentation in the English-language literature has been scarce. Eight fetal cell implantations have been done in this country. The first of these has been described in detail: that